ANNUAL REPORT

1962

CITY OF BRANTFORD

BRANTFORD SEWAGE TREATMENT PLANT

OPERATED FOR

THE CITY OF BRANTFORD

BY

THE ONTARIO WATER RESOURCES COMMISSION

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Prepared by the

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BRANTFORD SEWAGE TREATMENT PLANT

GENERAL

Late in the year of 1956, an agreement between the City of Brantford and the Ontario Water Resources Commission was signed for the construction and operation of a sewage treatment plant. In July of 1958, a sod turning ceremony took place and construction commenced. On February 24, 1960, the sewage from the City of Brantford was directed to the newly completed sewage treatment plant and the operation of the project became a reality.

The plant consists of both primary and secondary treatment. Primary treatment consists of mechanical means for the removal of objectionable material from the sewage. At the Brantford Sewage Treatment Plant the incoming sewage passes through bar screens, a grinding device, grit removal units and primary settling tanks. The secondary or "activated sludge" treatment involves the utilization of a biological floc to further reduce the amount of objectionable material. The sewage leaving the primary settling tanks enters the aeration tanks and there it is retained for about six hours while air is blown into the sewage. The mixed liquor from the aeration tanks goes to the final clarifiers. The settled solids from the final tanks are returned continuously to the aeration tanks and thus an activated sludge is built up. This activated sludge, in the presence of an adequate amount of air, is responsible for the further removal of objectionable material from the sewage. The clean effluent from the final tanks flows to a chlorine contact chamber and then to the

river with 90 - 95 % of its original objectionable material removed.

The settled solids from the primary tanks and the excess activated sludge from the final tanks are pumped to digestion tanks where their volume and organic content is reduced. As a result of the digestion, gas is produced which is used to heat the digestion tanks and the buildings at the plant.

A further reduction in the volume of sludge is achieved through the use of two vacuum filters. With these units the moisture of the sludge is reduced from 95 % to 80 % which represents a reduction in volume of about 75 %. The resulting filtered sludge is trucked to farm lands or is used as land fill while the liquid that is removed is returned to the treatment process.

DESIGN DATA

The 12.5 million gallons per day Brantford Sewage Treatment Plant cost $2,225,000. Consulting engineers for the project were Proctor & Redfern of Toronto. The equipment for the plant was supplied by the OWRC and the construction of the plant was carried out by Dunker Construction Limited.

(1) Inlet Works

The sewage enters the plant through a 36 inch diameter sewer and passes through a parshall flume where the flow is metered. From the parshall flume it divides and passes through two rotograters. The rotogrators employ bar screens to trap the larger solids and cutting knives to mascerate these solids. A bypass channel is provided

to facilitate any repairs of the rotogrators. Flow from the rotogrators is directed to two wet wells where it is pumped by four raw sewage pumps, each having a capacity of 5.5 million gallons per day, to two detritors located on the roof of the garage.

The detritors are circular, shallow tanks which allow sand and grit to settle. The washed grit is collected and removed from the detritor mechanically and stored in a large hopper. The grit is removed from the storage hopper and disposed of on the adjacent city sanitary land fill area.

(2) Primary Clarifiers

Four circular clarifiers, 70 feet in diameter, receive sewage from the grit removal units. It is retained in the clarifiers for 2 hours at design flow. Approximately 50 percent of the suspended solids in the incoming sewage settles to the bottom of the clarifiers. Each clarifier is equipped with a circular sludge collector which moves the settled sludge to a hopper located at the bottom of the clarifier. The sludge is then pumped to digestion tanks.

(3) Aeration Section

Settled sewage from the primary clarifiers flows by gravity to two triple-pass aeration tanks. There it is mixed with activated sludge which is returned from the final clarifiers and aerated. Each "pass" of the aeration tanks is 30 feet wide, 15 feet deep and 200 feet long. The total length of each aeration tank

is therefore 600 feet.

The aeration section retains the sewage for 6 hours at a flow rate of 12½ million gallons per day. This detention time is decreased by the flow rate of the return sludge.

It is possible to add the primary effluent to the aeration section at various points. This permits the use of modifications to the activated sludge process such as step aeration.

Air is supplied by three blowers each equipped with a 200 HP motor. Each blower is capable of delivering 13,800 cubic feet of air per minute.

(4) Final Clarifiers

The aerated mixed liquor from the aeration section is retained in four final clarifiers, identical in size to the primary clarifiers for two hours at design flow. This allows the activated sludge to settle and it is collected in the bottom of the tanks and returned to the aeration section or wasted. (Excess activated sludge is returned or "wasted" to the primary clarifiers where it settles and is pumped to the digesters.) The remaining liquid flows over the weirs of the final clarifiers, and is chlorinated in the chlorine contact chamber and flows to the river as plant effluent.

(5) Sludge Digestion Tanks

The Brantford plant utilizes two stage digestion. There are four digesters; two primary tanks each 55 feet in diameter and two secondary tanks each 70 feet in

diameter. The piping between the tanks is so arranged that it is possible to remove sludge from any one of the primary tanks to either of the secondary digesters. It is also possible to remove sludge from the primary digesters directly to the vacuum filtration area.

The primary digesters are equipped with fixed steel covers. Each is provided with two draft tube type mixers. Each secondary digester is provided with a floating gas holder steel cover. Heat is applied to the contents of the primary digestion tanks only.

(6) Vacuum Filters

Sludge from the digesters is pumped to two vacuum filters. Each filter has a filtering area of 350 square feet and employs coiled stainless steel springs as the filter media. The "drums" are placed under a vacuum and moisture is thus withdrawn from the sludge. Appurtenances included with the filters are vacuum pumps, filtrate receivers, lime and ferric chloride tanks, mixing tanks, and sludge pumps.

TABLE I

FLOW - MILLION GALLONS

MONTH	MAX. DAILY Flow	MIN. DAILY Flow	AVG. DAILY Flow	TOTAL MONTHLY Flow
Jan.	6.976	4.609	5.700	176.547
Feb.	6.200	4.377	5.425	151.607
Mar.	7.903	4.428	5.675	176.026
Apr.	7.302	4.758	6.216	186.491
May	7.056	5.160	6.347	196.744
June	6.900	5.500	6.442	193.245
July	6.000	4.800	5.597	185.500
Aug.	6.100	3.264	4.838	149.965
Sept.	6.700	3.900	5.027	150.800
Oct.	6.700	3.900	5.390	167.100
Nov.	6.600	4.300	5.743	172.300
Dec.	7.500	4.700	5.660	175.700
			68060	2082.025
Avg.			5.67	

Population based on 1961 Census = 55,201

Average flow per capita per day = $\frac{5,670,000}{55201}$ = 103

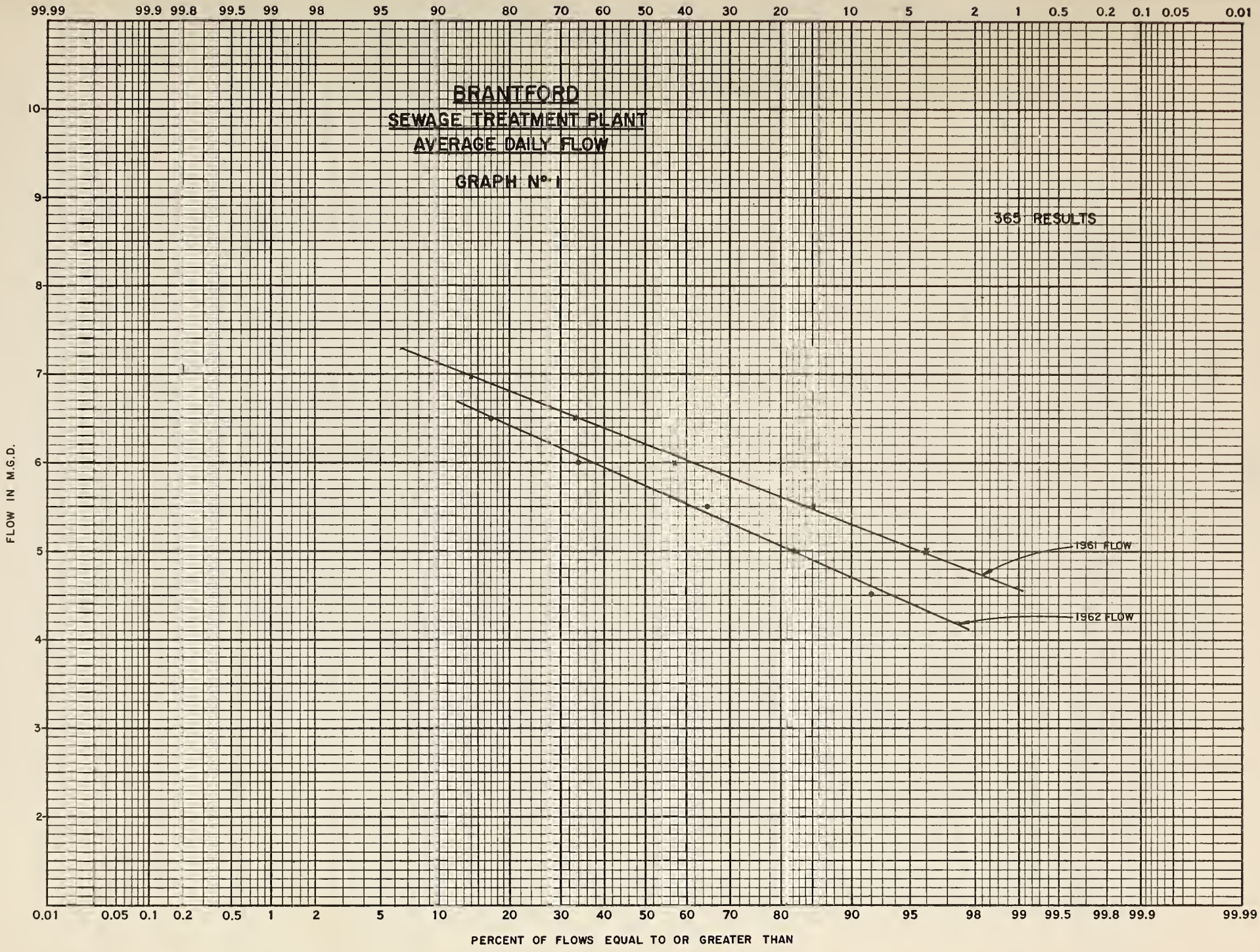

BRANTFORD
SEWAGE TREATMENT PLANT
AVERAGE DAILY FLOW
GRAPH Nº 1
365 RESULTS
1961 FLOW
1962 FLOW
FLOW IN M.G.D.
PERCENT OF FLOWS EQUAL TO OR GREATER THAN
99.99 99.9 99.8 99.5 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.5 99.8 99.9 99.99
10 9 8 7 6 5 4 3 2

TABLE II

GRIT, BOD, AND SS REMOVAL

MONTH	FLOW MGD	RAW SEWAGE		TONS BOD REMOVED	TONS S.S. REMOVED	CU. FT. GRIT REMOVED
		BOD PPM	S. S. PPM			
Jan.	5.70	246	198	205	136	371
Feb.	5.42	264	222	192	146	466
Mar.	5.68	183	202	154	158	600
Apr.	6.22	230	203	207	176	747
May	6.35	223	178	209	149	797
June	6.44	163	193	145	180	735
July	5.60	160	193	139	178	649
Aug.	4.84	175	224	125	158	755
Sept.	5.03	253	242	185	171	1,242
Oct.	5.39	222	220	176	177	1,000
Nov.	5.74	256	239	196	205	1,676
Dec.	5.66	258	197	212	161	1,144
TOTAL				2,145	1,995	10,182
AVERAGE				179	166	848

Grit = 4.9 cubic feet/MG

BOD = 1.03 tons per MG. SS = 0.96 tons per MG

OPERATING RESULTS

Flow

Flow data on the plant is listed in Table I. During 1962 the average daily flow for the year was 5.67 million gallons per day compared with an average of 6.12 million gallons per day in 1961.

The maximum daily 24 hour flow for the year was 7.9 million gallons and occurred in the month of March. The month with the greatest average daily flow was June.

The total flow for the year was 2082 million gallons, a decrease of 10 per cent from the total flow of 2280 million gallons in 1961.

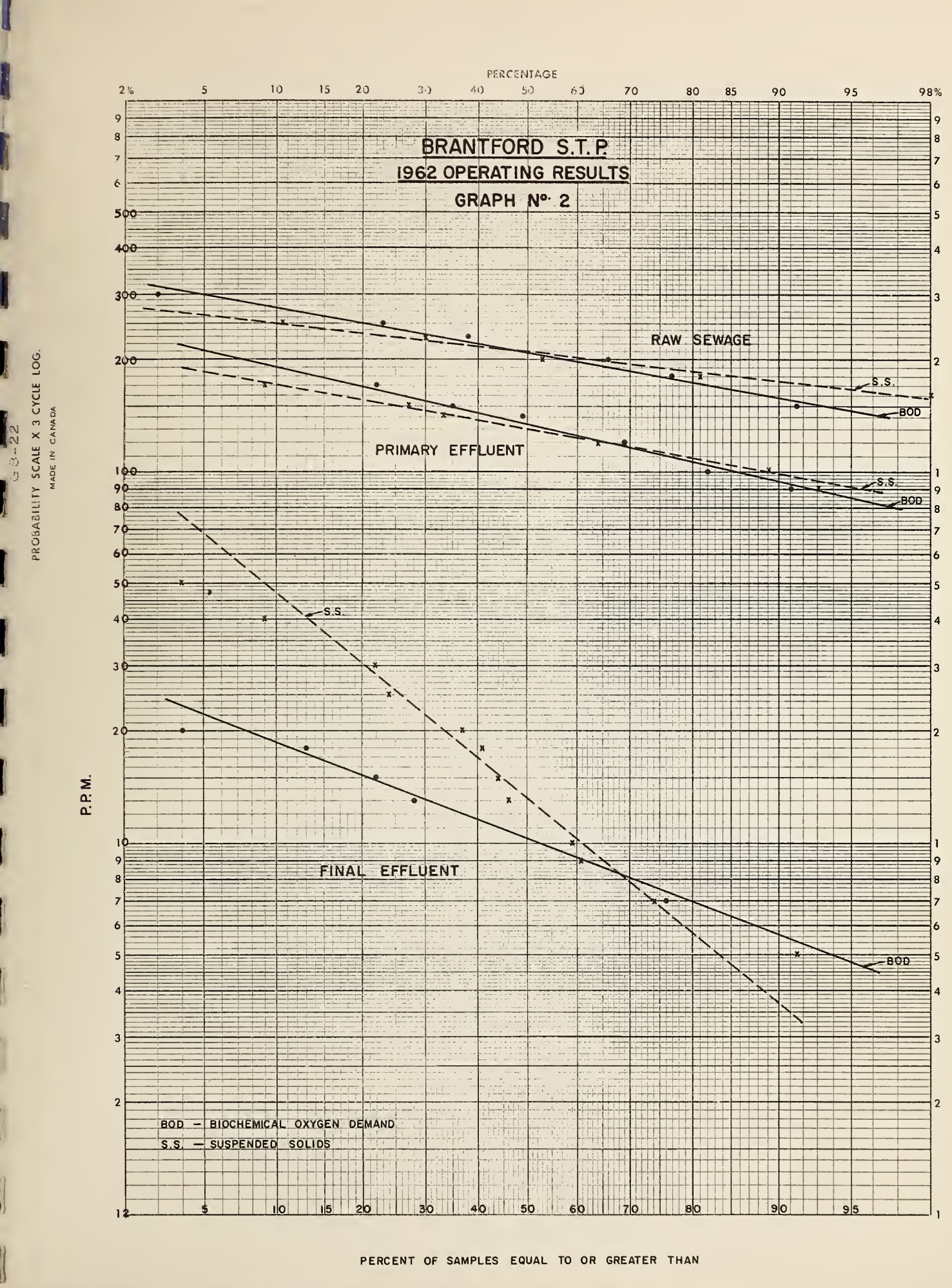
It is expected that the total flow in 1963 will rise due to increased industrial flow.

Grit Removal

An average of 28 cubic feet of grit was removed daily at the plant. This is a significant increase over the average of 17 cubic feet in 1961 and appears to be due to the high grit loads received during the last four months. The cause of the increased grit load is not known but the situation will be investigated to determine if there are any significant trends.

Raw Sewage

Graph Number 2 indicates the concentration of BOD and SS in the raw sewage, primary effluent and final effluent. It is seen that the average BOD and SS of the raw sewage are both 210 ppm. This is not a significant difference from 1961 when the average BOD and SS were 190 and 220 respectively. The raw sewage


PERCENTAGE
2% 5 10 15 20 30 40 50 60 70 80 85 90 95 98%
BRANTFORD S.T.P.
1962 OPERATING RESULTS
GRAPH Nº. 2
RAW SEWAGE
S.S.
BOD
PRIMARY EFFLUENT
S.S.
BOD
S.S.
FINAL EFFLUENT
BOD
BOD — BIOCHEMICAL OXYGEN DEMAND
S.S. — SUSPENDED SOLIDS
P.P.M.
PERCENT OF SAMPLES EQUAL TO OR GREATER THAN
PROBABILITY SCALE X 3 CYCLE LOG.
MADE IN CANADA
C 3-22

is of moderate strength and does not fluctuate widely. For [illegible], 90 per cent of the raw sewage has a BOD between [illegible] and 300 ppm and an SS between 170 and 260 ppm.

PRIMARY TREATMENT

Graph Number 2 indicates that the primary effluent has an average BOD of 135 and an average SS of 130 p.p.m. This shows a slight increase from 1961 when the BOD and SS were 105 ppm and 115 ppm respectively.

AERATION UNIT

Table Number [illegible] indicates the operating performance of the aeration section of the plant. It is seen that the aeration section receives primary effluent with a BOD of approximately 140 ppm. The average concentrations for each month varies from 93 to 177 ppm. From Graph Number 2 it can be seen that 90 % of the primary effluent has a BOD between 83 and 210 ppm.

The loading on the aeration tank averaged 10 pounds BOD per 100 lbs. of M.L.S.S. which is below a normally accepted

M.L.S.S. = Mixed liquor suspended solids

value. This ratio should be between 20 and 40. If the ratio should increase to 50, the aeration section would be "overloaded" and its efficiency would fall off rapidly. If the ratio falls below 20, there is a tendency for "pin point" floc to escape in the final effluent and increase the suspended solids concentration.

The aeration section operated with a very low loading all year. At present, it is necessary to use either one-half or all of the aeration capacity. The use of one-half of the aeration capacity was attempted early in 1961 but it was found that high concentrations of BOD experienced at certain times would cause difficulties and the plan was abandoned.

It is anticipated that the BOD load to the plant will increase in 1963 due to an additional trunk sewer and possibly the acceptance of certain industrial wastes. This additional BOD should improve the loading on the aeration section.

Another cause of the low loading in the aeration tank is the high mixed liquor suspended solids carried in the aeration tanks.

Some difficulty has been encountered in reducing the mixed liquor suspended solids by wasting into the primary tanks. A large volume of activated sludge wasted to the primary tanks tends to raise the sludge blanket in the primaries and reduce the concentrations of solids going to the digester. This, in turn, reduces the concentration of solids going to the vacuum filters and raises the filter operating costs.

This problem is presently under consideration and it is hoped that a satisfactory solution can be found.

TABLE III

AERATION SECTION

MONTH	PRIM. EFF. BOD PPM	MLSS PPM	LBS.BOD PER 100 LBS.MLSS	CU.FT. AIR PER LB.BOD REMOVED	CU. FT. AIR PER GALLON OF SEWAGE
Jan.	151	1795	14.5	745	1.02
Feb.	154	1840	13.8	820	1.17
Mar.	135	2110	11.0	990	1.26
Apr.	136	2385	11.8	1220	1.28
May	154	2435	12.2	1230	1.77
June	108	2810	7.5	1900	1.81
July	93	2660	6.0	2310	1.97
Aug.	104	2476	6.0	2620	2.24
Sept.	134	2616	7.8	1800	2.25
Oct.	155	2640	8.0	1820	2.16
Nov.	174	3000	10.0	1291	2.10
Dec.	177	3280	9.0	1270	2.09
TOTAL:	1675	30047	1176	18016	2112
AVERAGE:	140	2500	9.8	1500	1.76

M.L.S.S. = mixed liquor suspended solids

DIGESTER OPERATION - Table IV

During 1962, 8,125,300 gallons of sludge at an average concentration of 4.2 per cent solids were pumped to the digesters. This is a decrease of about 2 per cent from the 8,269,000 gallons pumped in 1961. In addition the solids pumped were slightly lighter. This reduction is due to the 10 per cent reduction in plant flow.

A total of 16,511,500 cubic feet of gas was produced in the digesters in 1962 compared with 17,900,100 cubic feet in 1961.

The cubic feet of gas produced per pound of volatile matter in raw sludge was 7.3 which is within the average accepted values of 6 to 10.

TABLE IV

DIGESTER OPERATION

MONTH	SLUDGE TO DIGESTERS 1000's Gal.	% Solids	% * Vol.	DIGESTED Sludge * % Vol.	% Red. of * Vol.	Gas Produced 1000's Cu.Ft.	GALLONS Sludge From Digeste
Jan.	758.8	3.7	70.3	51.4	55	1,792.7	783.1
Feb.	726.1	3.4	70.5	50.5	47	1,603.8	832.9
Mar.	772.7	4.0	68.0	46.5	49	1,551.5	473.6
Apr.	699.3	4.6	66.3	56.3	35	1,423.5	612.1
May	770.5	4.6	64.0	57.8	21	1,529.4	543.4
June	622.0	4.0	64.5	57.0	27	1,200.2	557.7
July	612.7	4.6	65.4	56.0	33	1,210.8	387.7
Aug.	472.0	4.8	63.0	56.6	23	1,005.6	465.4
Sept.	598.1	4.3	68.0	54.9	40	1,183.2	543.7
Oct.	719.7	3.7	66.4	55.5	37	1,063.8	691.2
Nov.	694.0	4.2	65.5	56.5	32	1,315.1	718.9
Dec.	679.4	4.6	66.5	56.9	34	1,631.9	764.4
TOTAL:	8125.3	---	---	---	--	16,511.5	-----
AVG:	677.1	4.2	66.5	54.7	36	1,375.9	

P = Percent reduction of volatile matter
R = Percent volatile matter in raw sludge
D = Percent volatile matter in digested sludge

Vol. = Volatile Matter

$$P = \left[1 - \frac{(100 - R)D}{(100 - D)R} \right] 100$$

VACUUM FILTER OPERATION

Table V indicates the results of the vacuum filter operation. It is seen that in a total of 2519 hours of filtering, the two units filtered a total of 3,816,540 pounds of sludge using 570,631 pounds of lime and 198,737 pounds of ferric chloride.

During 1962 the yield in pounds per square foot per hour decreased from 3.51 in 1961 to 3.17 in 1962. It is felt that this decrease was due to the slightly lower concentration of solids pumped to the filters.

SLUDGE HAULAGE

The filtered sludge is discharged to a concrete pad where it is picked up and hauled to the city dump. The volume of sludge hauled was only 31 per cent of the sludge pumped to the digesters.

FINAL EFFLUENT

Graph Number 2 indicates the concentrations of the BOD and SS in the final effluent are 10 and 13 ppm. Both of these averages are below the Commission objective of 15 ppm. This is a significant improvement over 1961 when the average BOD and SS were 8 and 28 ppm respectively. This was due to the additional operating experience obtained during 1961.

It is seen that the Commission's objective for BOD was exceeded only 20 per cent of the time and for SS 45 per cent of the time. The reason for the higher concentration of SS is that the aeration section is being operated in an under-loaded condition and therefore, there is a tendency for "pin point" floc being discharged in the effluent.

TABLE V

VACUUM FILTER OPERATION

MONTH	FILTER HOURS #1	#2	% SOLIDS DIGESTED SLUDGE	POUNDS DRY SOLIDS	LBS LIME	% LIME	LBS $FeCl_3$	% $FeCl_3$	% Moist.	YIELD P.S.F /HR
Jan.	194.33	191.7	5.17	408,981	61,880	15.2	24,502	6.0	86.7	3.04
Feb.	208.42	205.65	5.15	431,754	66,594	15.5	28,795	6.7	86.0	2.99
Mar.	136.00	110.00	4.98	235,184	52,136	15.5	14,114	6.0	85.9	2.94
Apr.	150.59	159.84	5.00	319,991	48,902	15.1	17,351	5.4	85.3	2.96
May	130.00	128.00	5.14	270,721	41,524	14.9	13,793	5.0	85.1	3.10
June	121.65	139.16	4.97	277,126	41,055	15.0	13,202	4.8	84.1	3.12
July	119.00	119.00	4.94	264,951	37,450	14.2	12,421	4.7	84.4	3.19
Aug.	116.50	98.50	5.63	260,795	33,600	12.9	11,205	4.3	84.6	3.47
Sept.	124.49	130.50	5.76	300,214	40,005	13.3	13,199	4.4	84.0	3.50
Oct.	156.50	156.83	5.37	378,153	51,730	13.9	18,262	5.0	84.7	3.45
Nov.	196.32	130.16	5.52	375,642	52,495	13.9	17,737	5.1	84.5	3.47
Dec.	147.16	148.50	4.73	293,028	43,260	14.7	14,156	4.4	85.3	2.83
TOTAL:	1800.96	1717.84	---	3,816,540	570,631	---	198,737	---	---	38.06
AVG:	150.08	143.15	5.20	318,045	47,552	14.5	16,561	5.1	85.1	3.17

BRANTFORD TABLE VI

OPERATING COSTS 1962

MONTH	TOTAL EXPENDITURE	PAYROLL	CASUAL PAYROLL	FUEL	POWER	CHEMICAL	GENERAL SUPPLIES	EQUIPMENT	REPAIRS & MAINT.	SUNDRY	WATER
JAN.	11479.83	7735.65	-----	463.88	1608.15	608.10	236.49	5.85	167.77	426.72	238.92
FEB.	12251.62	7776.31	-----	394.04	1582.23	1605.57	410.89	-----	100.74	381.84	------
MAR.	14230.05	7766.78	-----	969.88	1556.31	2087.22	501.97	226.80	93.20	736.05	291.84
APR.	11256.75	7766.78	-----	------	1698.44	1574.70	76.72	(226.80)	155.04	211.87	------
MAY	13675.38	7562.33	-----	589.09	1848.65	1810.37	776.41	145.54	36.50	906.49	------
JUNE	13264.54	7567.34	210.42	133.69	1828.26	2262.80	370.44	------	71.38	820.21	------
JULY	15407.07	7730.94	266.40	105.64	1892.84	4601.89	255.46	------	------	308.04	245.86
AUG.	16684.44	11547.06	426.29	64.60	1782.68	1943.29	335.19	75.93	39.10	471.00	------
SEPT.	12939.37	7663.26	108.56	47.65	1834.95	1455.20	193.48	-------	131.50	699.36	805.41
OCT.	10847.73	7984.41	------	26.88	1764.29	706.35	208.27	-------	42.00	115.53	------
NOV.	10567.18	7242.83	------	155.82	1878.40	(764.12)	334.81	204.97	38.45	941.74	534.28
DEC.	18427.51	10905.50	------	387.67	1299.54	3331.84	698.03	266.04	229.50	709.39	------
TOTAL	161031.47	99249.19	1011.67	3338.84	21174.74	21223.21	4398.16	685.83	1105.28	6728.24	2116.31

NOTE: Sundry includes $3,000.00 for sludge haulage

OPERATING COSTS

In 1962 the total operating costs for the Brantford Sewage Treatment Plant were 161,031.47 which was within the estimated budget of $162,900.00.

In Table VI the monthly operating costs are indicated under various headings.

The Table below indicates the costs for sewage treatment during 1960, 1961 and 1962.

YEAR	MG TREATED	TOTAL COST	COST PER 1000 GALS	COST PER CAPITA PER YEAR
1960	1978	122,860.77	6.2 ¢	$ 2.70 *
1961	2287	155,665.80	6.8	$ 2.86
1962	2082	161,031.47	7.7 ¢	$ 2.92

* Cost per capita extended to 12 months rather than 10 months plant actually operated.

The 1962 costs were based on a population of 55201.

VACUUM FILTER COSTS

Labour	- estimated at 2.50 per filtering hour	$ 4400
Power	- estimated at $1.40 per dry ton	$ 2670
Lime	- at $18.00 per ton	$ 5130
Ferric Chlorine	- at 6.65 per 100 lbs.	$13200
Maintenance	- at 0.20 per dry ton	380
	Total Estimated Costs	$ 25680

During 1962 a total of 1900 tons of dry sludge were filtered. Therefore, the cost of filtering was $13.60 per ton, dry weight.

PLANT STAFF

At present the plant staff consists of the following :-

1	Plant Superintendent
5	Shift Foreman
10	Shift Operators
1	Filter Operator
1	Laboratory Technician
1	Maintenance Foreman
1	Maintenance mechanic
1	Groundskeeper
1	Assistant Groundskeeper
1	Clerk

On September 30th, 1962 Mr. L. Sharman resigned his position as plant superintendent to accept the position of superintendent for the City of Hamilton Sewage Treatment Plant. Mr. Sharman had been the superintendent since the plant opened.

Subsequently Mr. G. Bragg, one of the shift foreman, was promoted to the position of superintendent. Mr. E. Percival was promoted from shift operator to shift foreman to fill the vacancy left by Mr. Bragg.

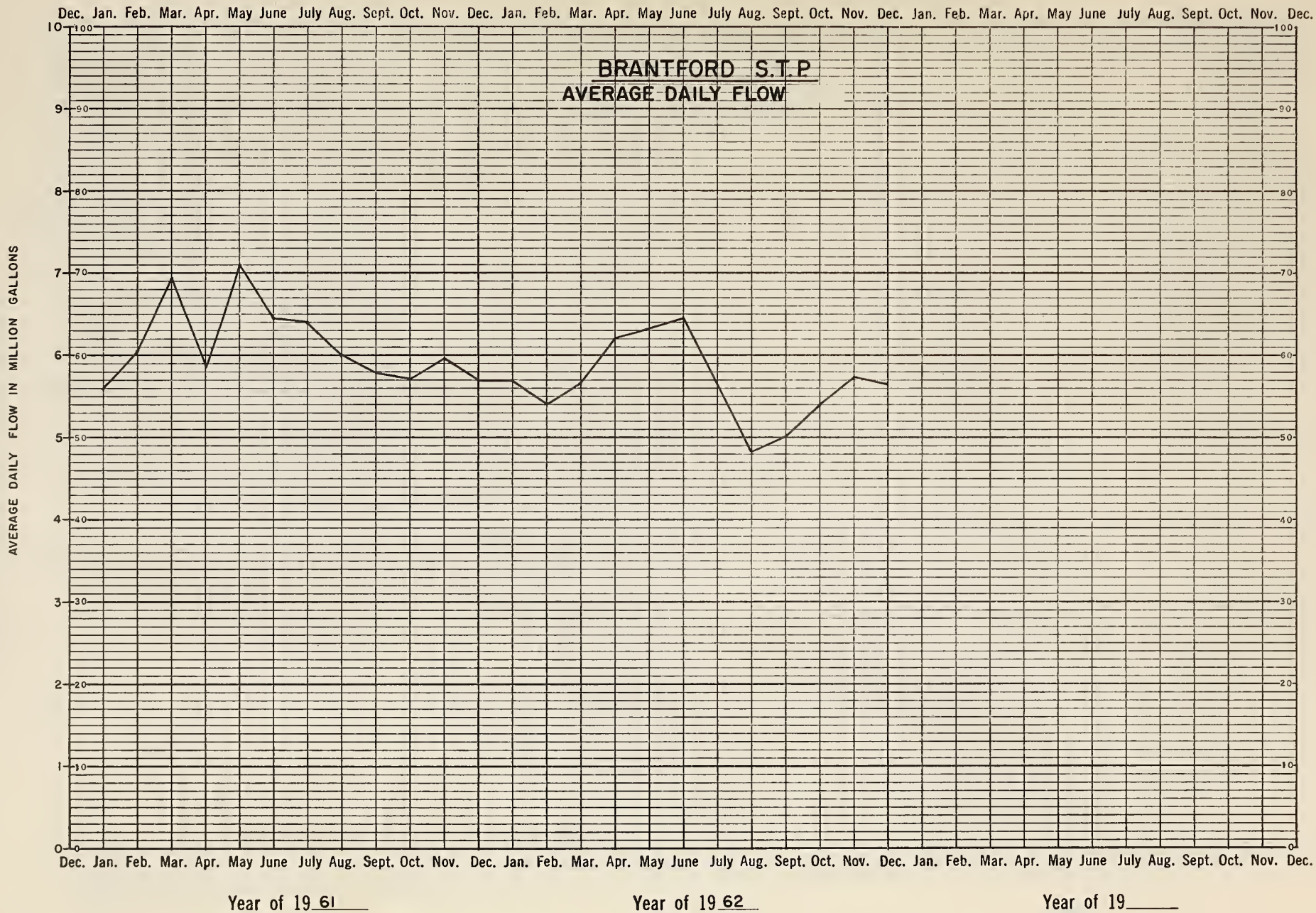
On January 1st, 1963 Mr. N. Gross, a shift operator, resigned to accept the position of Assistant Superintendent in the City of Hamilton Sewage Treatment Plant.

Two shift operators were hired to fill the vacancies left by the resignation of Mr. Gross and the promotion of Mr. Percival.

GC 8-66

Three Years by Months X 100 Divisions

MADE IN CANADA



Year of 19 61 Year of 19 62 Year of 19____

GC 8-66

Three Years by Months X 100 Divisions

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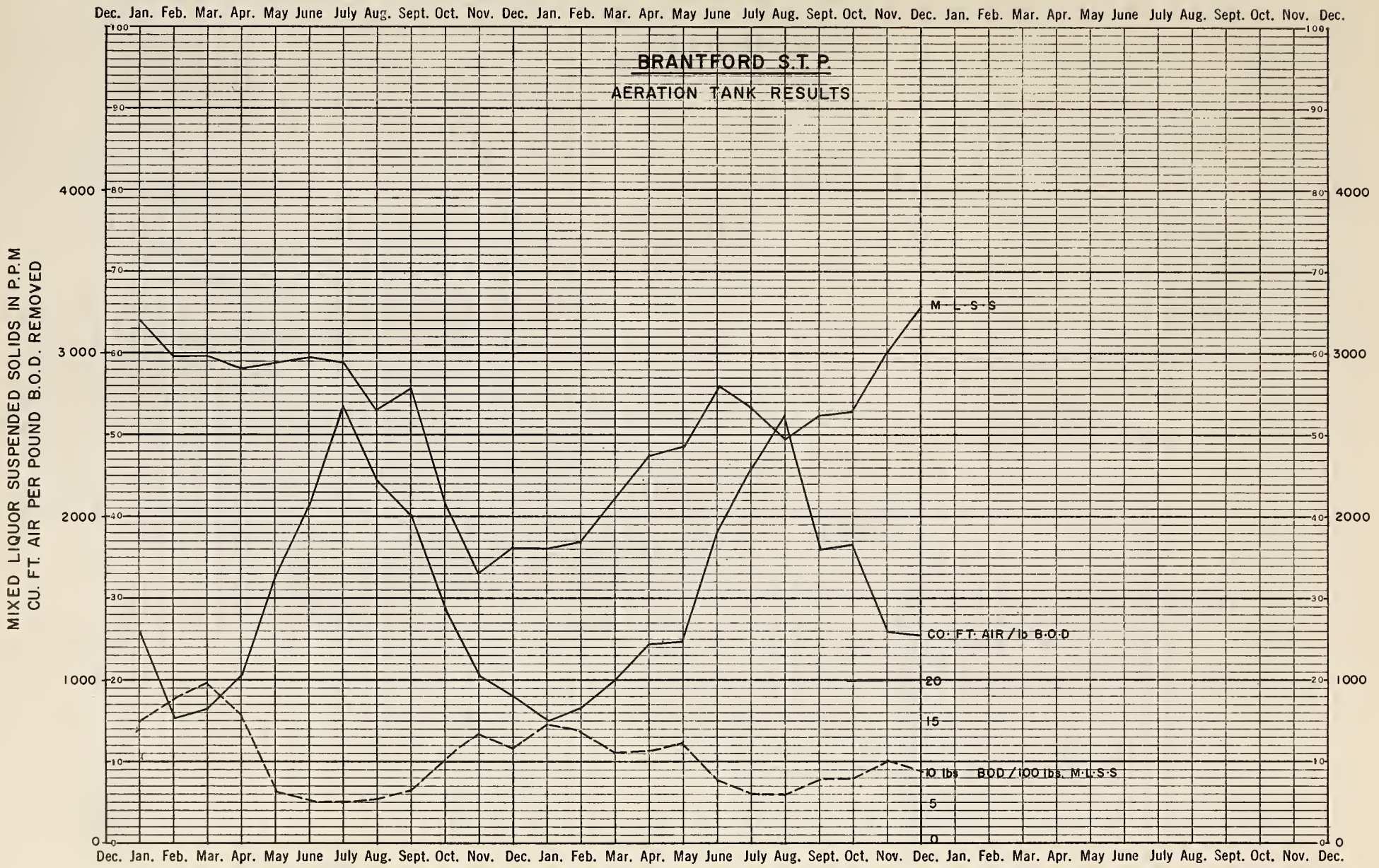

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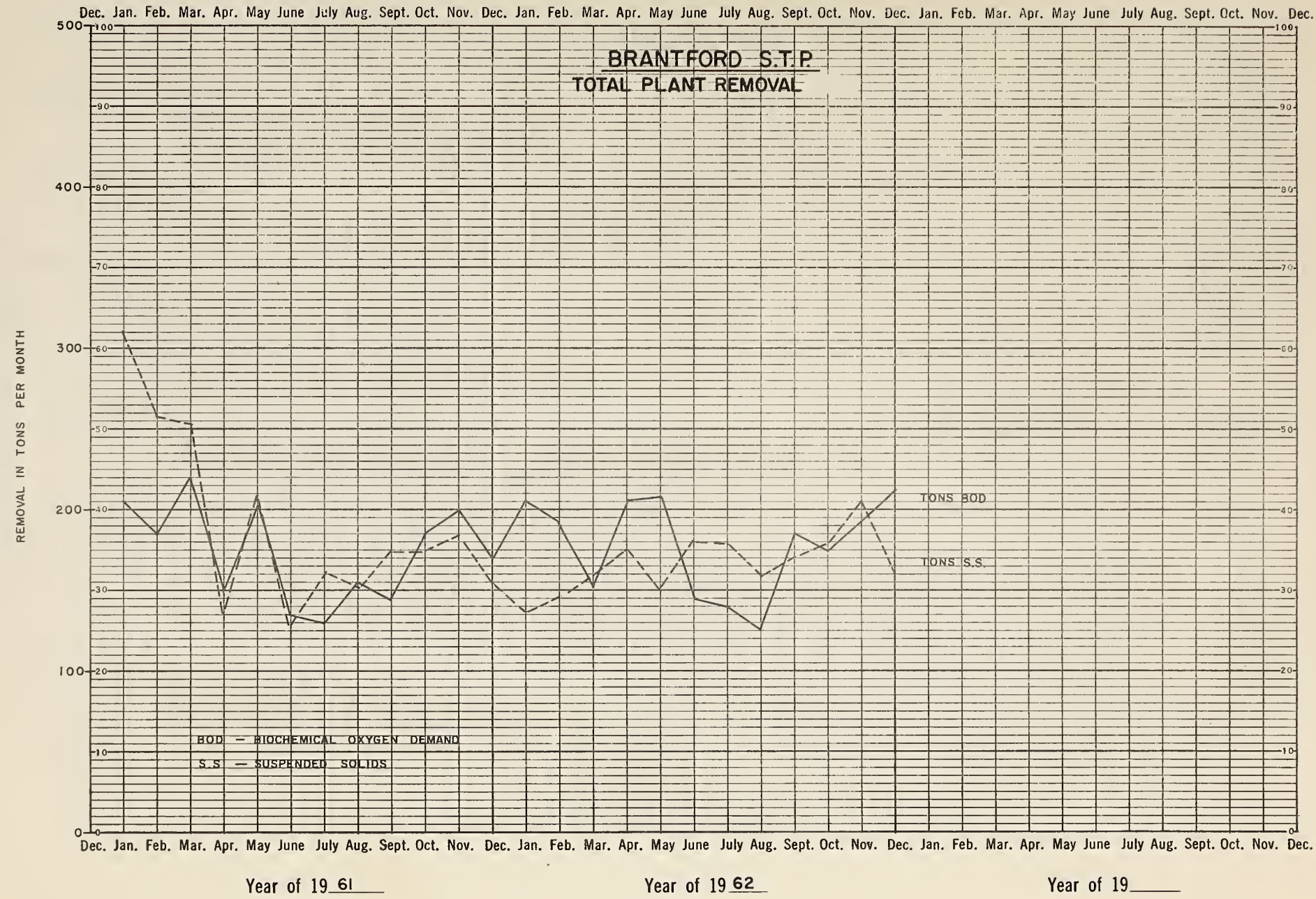
GC 8-66

Three Years by Months X 100 Divisions

MADE IN CANADA

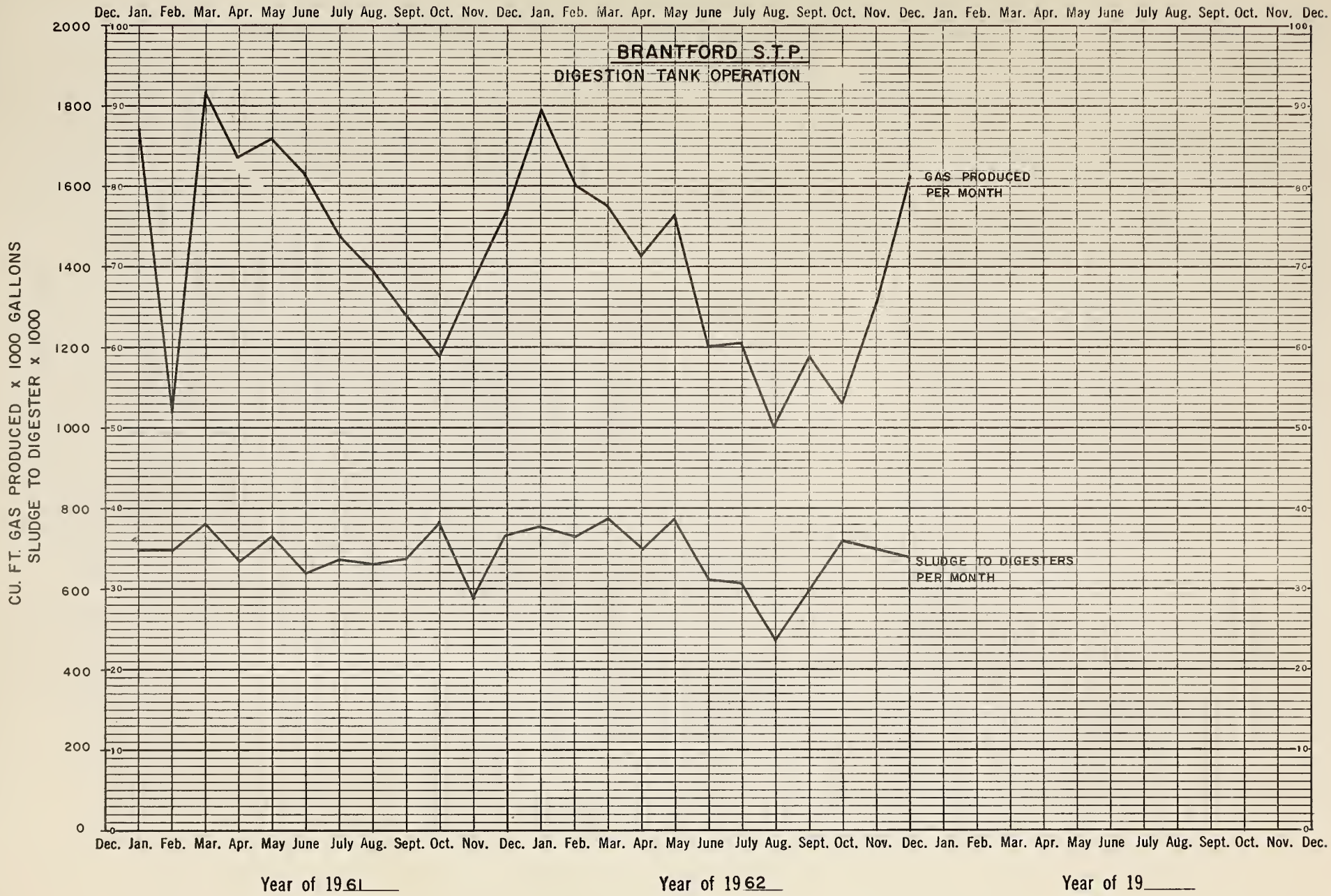


Year of 19 61 Year of 19 62 Year of 19 ____

GC 8-66

Three Years by Months X 100 Divisions

MADE IN CANADA

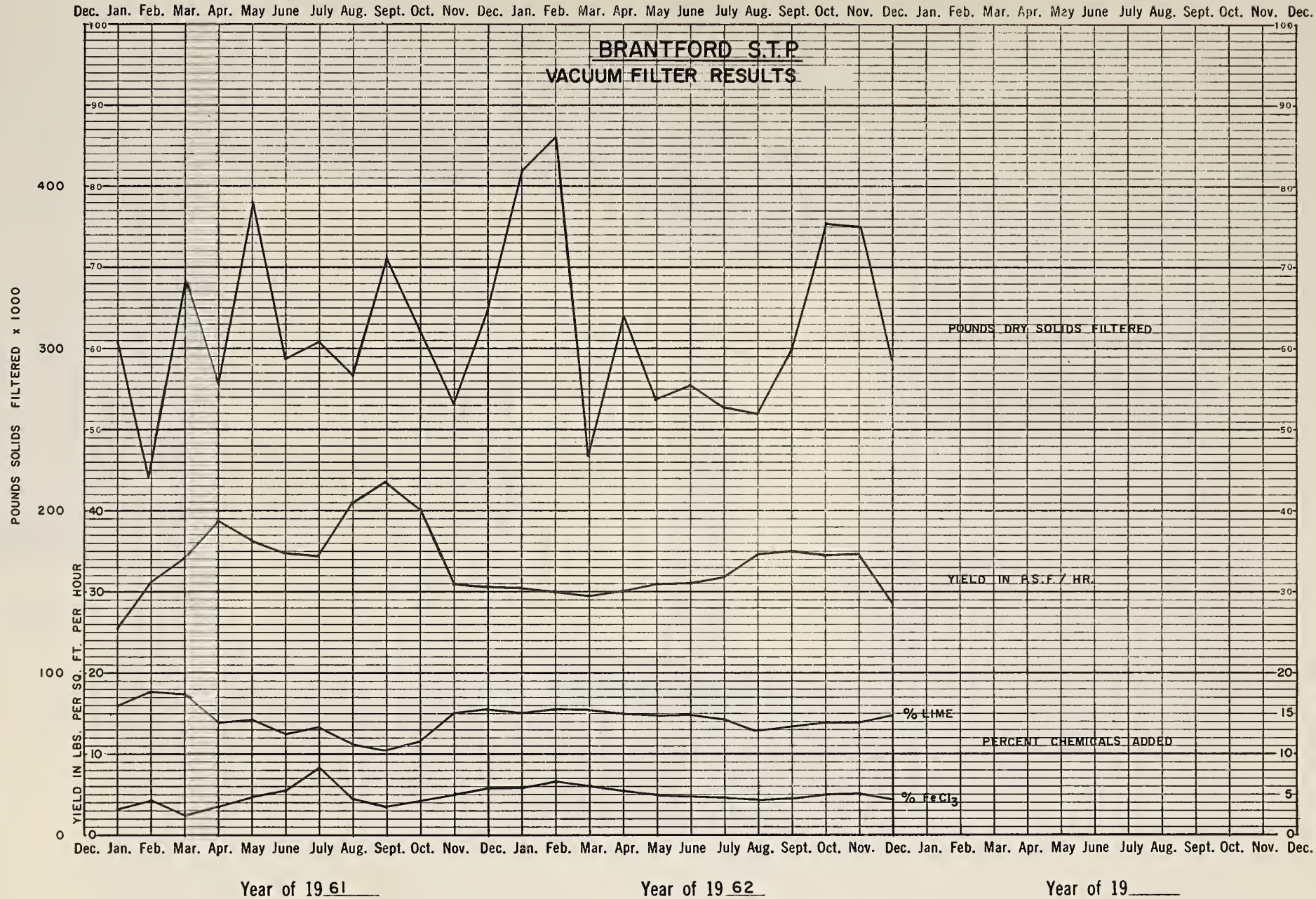


Year of 1961 Year of 1962 Year of 19____

GC 8-66

Three Years by Months X 100 Divisions

MADE IN CANADA



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